Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army												Date: March 2014
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	62.267	64.555	72.883	-	72.883	69.342	70.127	68.882	67.830	-	-
C05: *Armor Applied Research*	-	25.350	27.023	31.414	-	31.414	29.467	28.617	26.304	25.494	-	-
H77: *National Automotive Center*	-	14.695	15.031	15.640	-	15.640	15.853	16.027	16.308	16.421	-	-
H91: *Ground Vehicle Technology*	-	22.222	22.501	25.829	-	25.829	24.022	25.483	26.270	25.915	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

FY 13 decrease is attributed to for Congressional General reductions (-141 thousand); SBIR/STTR transfers -958 thousand); and Sequestration reductions (-5.696 million)

A. Mission Description and Budget Item Justification

This program element (PE) researches, designs, and evaluates combat and tactical vehicle automotive technologies that enable the Army to have a lighter, more survivable, more mobile and more deployable force. Project C05 investigates, researches, and evaluates advanced ground vehicle design and occupant protection technologies in such areas as armor concepts, ballistic defeat mechanisms, blast mitigation, survivability modeling and simulation (M&S), hit avoidance, kill avoidance, safety, sensors, instrumentation and survivability packaging concepts to achieve superior survivability/protection for Soldiers and military ground vehicles. Project H77 funds the National Automotive Center (NAC), which was chartered by the Secretary of the Army to conduct shared government and industry, or "dual use", technology programs to leverage commercial investments in automotive technology research and development for Army ground combat and tactical vehicle applications. Project H91 designs, matures, and evaluates a variety of innovative and enabling technologies in the areas of electrical power, thermal management, propulsion, mobility, power for advanced survivability, vehicle diagnostics, fuels, lubricants, water purification, intelligent systems, autonomy-enabled systems, and other component technologies to enhance the mobility, power and energy and reduce the logistic chain of combat and tactical vehicles.

Work in this PE is related to, and fully coordinated with, 0602105A (Materials Technology), 0602618A (Ballistics Technology, Robotics Technology), 0602705A (Electronics and Electronic Devices), 0602716A (Human Factors Engineering Technology), 0603005A (Combat Vehicle and Automotive Advanced Technology), 0603125A (Combating Terrorism – Technology Development), 0603734 (Military Engineering Advanced Technology), and 0708045A (Manufacturing Technology).

Work in this PE is coordinated with the U.S. Marine Corps, the Naval Surface Warfare Center, and other ground vehicle developers within the Defense Advanced Research Projects Agency (DARPA) and the Departments of Energy, Commerce, and Transportation.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this PE is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army	Date: March 2014
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	69.062	64.589	72.309	-	72.309
Current President's Budget	62.267	64.555	72.883	-	72.883
Total Adjustments	-6.795	-0.034	0.574	-	0.574
• Congressional General Reductions	-0.141	-0.034			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.958	-			
• Adjustments to Budget Years	-	-	0.574	-	0.574
• Sequestration	-5.696	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*	Project (Number/Name) C05 / *Armor Applied Research*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
C05: *Armor Applied Research*	-	25.350	27.023	31.414	-	31.414	29.467	28.617	26.304	25.494	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project investigates, researches, and evaluates advanced ground vehicle design and occupant protection technologies in such areas as armor concepts, ballistic defeat mechanisms, blast mitigation, survivability modeling and simulation (M&S), improved situational awareness, hit avoidance, kill avoidance, safety, sensors for blast, crash and rollovers, instrumentation and survivability packaging concepts to achieve superior survivability/protection for Soldiers and ground combat and tactical vehicles. Survivability/protection technologies are being investigated to meet anticipated ground combat and tactical vehicle survivability objectives. Additionally, this project focuses on analysis, modeling, and characterization of potential survivability solutions that could protect against existing and emerging threats. This analysis is used to aid in the identification of technologies to enter maturation and development in PE 0603005A, project 221.

This project supports Army science and technology efforts in the Ground portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC) Warren, MI and is fully coordinated with work at the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD and at Communications-Electronics Research, Development and Engineering Center (CERDEC), Aberdeen Proving Ground, MD and Fort Belvoir, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Advanced Armor Development:	8.353	11.444	15.250
Description: The objective of this effort is to design, integrate and validate performance of advanced armor systems to defeat single and multiple chemical and kinetic energy (CE and KE) emerging threats for combat and tactical vehicles. These systems include base armor (small arms / medium caliber opaque B-kits and transparent), applique armor (passive / reactive / active multi-threat C-kits) and multifunctional armor (embedded antennas & health monitoring devices).			
FY 2013 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed a high-performance lightweight armor recipe by conducting risk mitigation and system level multi-hit ballistic validation evaluation; conducted health monitoring into armor recipe and design; created techniques and procedures for integration of advanced armors. ***FY 2014 Plans:*** Provide initial characterization of next generation advanced light weight combat vehicle armors for identification of future maturation risk; conduct initial performance and cost trade analysis on the integration of advanced armor technologies; and perform environmental and ballistic testing on vehicle size armor coupons for system level integration. ***FY 2015 Plans:*** Will continue characterization of next generation advanced light weight combat and tactical vehicle armors; will perform environmental and ballistic testing, along with modeling and simulation integration analysis for combat and tactical objective threat based laminate and encapsulated kinetic energy armor systems (B Kits); will perform risk mitigation and integration analysis for combat vehicle threat based passive, reactive and electromagnetic chemical energy armor systems (C Kits); will explore adaptive armor applicability and related platform integration techniques to reduce armor weights while increasing protection levels.			
Title: Blast Mitigation: ***Description:*** This effort designs, fabricates and evaluates advanced survivability and protection capabilities, tools and technologies to improve protection against vehicle mines, improvised explosive devices (IEDs) and other underbody threats and crash events. This effort also designs and evaluates technologies purposed for protecting the occupant such as seats and restraints. This effort creates the laboratory capability needed to enable expeditious research and development of blast-mitigating technologies. Blast and crash mitigation technologies are further investigated and matured in such areas as active and passive exterior/hull/cab/kits, interior energy absorbing capabilities for seats, floors, restraints, sensors for active technologies and performance evaluation, modeling and simulation (M&S), experimentation and instrumentation. This effort supports the Occupant Centric Platform (OCP) program. ***FY 2013 Accomplishments:*** Leveraged defense, automotive and medical communities to research innovative occupant protection technologies such as restraints, hull structure designs, seats, and crash event simulation tools; refined finite-element M&S tools for quicker assessment of occupant protection technologies; developed a Multi-Axis Blast Simulator (MABS) for rapid component-level testing; matured and evaluated occupant protection technologies in such areas as exterior protection technologies, interior protection technologies, sensor technologies and instrumentation technologies; Created 3D CAD models of the OCP Demonstrator to further refine and validate the design through M&S; created standards for occupant protection against underbody blasts and crashes to capture and document the best practices of occupant protection. ***FY 2014 Plans:***	12.098	11.141	9.284

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Further research innovative approaches and improve occupant protection capabilities in mitigating underbody blast, crash and rollover injuries in areas such as seats, restraints, protective trim, hull structures, and energy absorbing materials and approaches; refine and employ modeling and simulation (M&S) tools for assessing occupant protection technologies; develop laboratory tools to better assess integrated components, sub-system and system level responses for protection of Soldiers in underbody blast, crash and rollover events; leverage and expand on defense, automotive and medical community efforts for improving vehicle exterior, interior and sensor capabilities; continue incorporating lessons learned into occupant protection standards and guidelines; and advance instrumentation capabilities such as anthropometric test devices and blast data collection for research. ***FY 2015 Plans:*** Will research and conduct experiments to evaluate the use of advanced passive and active approaches to mitigate the effects of underbody blast threats in areas such as seats, restraints, energy absorbing materials and active blast countermeasures; will conduct tests to evaluate the integration of exterior and interior blast mitigation solutions onto the OCP demonstrators, vehicle systems, test assets and/or sub-systems; will verify and validate occupant centric design guidelines/standards, M&S tools, test procedures, laboratory processes, experimentation capabilities; will research means to allow mechanical countermine tactics or products to be more effective; support testing of new instrumentation capabilities being developed by other programs such as WIAMAN Generation 1 blast dummy.			
Title: Synergistic Vehicle Protection Technologies: ***Description:*** This effort investigates and integrates advanced synergistic survivability technologies and simulation tools to provide enhanced protection for ground vehicles while minimizing overall system burdens. Synergistic survivability technologies such as, armor and active protection, offer the potential of non-linear survivability improvements. The modular approach facilitates trade-offs between protection, payload, performance, cost drivers and performance of vulnerability assessments throughout the life cycle of a system. Provides quantifiable metrics for development of requirements and evaluation of concept feasibility in the development of survivable combat systems. This effort supports the OCP program. ***FY 2013 Accomplishments:*** Synergized vehicle survivability technologies to optimize protection during multi-threat, multi-aspect engagements; designed and evaluated assessment methodologies for quantifying and mitigating post-engagement damage and crew casualties from effects such as fire and blast; provided enhanced capabilities to support combat modeling such as COMBAT XXI by providing rapid vehicle/weapon interaction modeling. ***FY 2014 Plans:*** Provide rapid organization and assessment of threat/countermeasure interaction reducing the overall burden on systems; design and develop modeling and simulation capability to optimize vehicle protection; design modeling capabilities to represent blast	4.899	4.438	3.873

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** C05 / *Armor Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
technologies for tradeoff analysis; provide quick reaction capability to quantify platform baseline survivability and prioritize enhancements. ***FY 2015 Plans:*** The effort will provide enhanced capabilities for protected mobility and survivability optimization to support combat modeling, and assessment of technologies that provide enhanced protection with minimum increase in system burdens; will provide enhanced assessment methodologies for quantifying and mitigating post-engagement damage and crew casualties from effects such as blast and fire; and will provide enhanced assessment methodologies for mobility and survivability on protected mobility.			
Title: Improved Situational Awareness for Ground Platforms ***Description:*** This effort investigates situational awareness (SA) technologies and architectures to improve occupant and vehicle survivability through increased situational awareness (SA) in all conditions and environments to include degraded visual environments (DVE) for ground vehicles. This effort also investigates and analyzes electronic architectures to enable the efficient integration of DVE systems such as intra-vehicle data and video networks, SA input/output devices, and associated software architectures and interfaces. This effort coordinates with PEs 0603005A, 0602709A, and 0603710A. ***FY 2015 Plans:*** The effort will conduct initial investigation of video and data architectures that enable the efficient integration of degraded visual environment (DVE) situational awareness (SA) technologies. This effort will also conduct feasibility analysis, trade studies and interface definitions of DVE SA technologies from aviation and commercial applications onto ground combat and tactical vehicles utilizing advanced vehicle digital architectures.	-	-	3.007
Accomplishments/Planned Programs Subtotals	25.350	27.023	31.414

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*	Project (Number/Name) H77 / *National Automotive Center*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H77: *National Automotive Center*	-	14.695	15.031	15.640	-	15.640	15.853	16.027	16.308	16.421	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project funds the National Automotive Center (NAC), which was chartered by the Secretary of the Army to conduct shared government and industry (dual use) technology programs to leverage commercial investments in automotive technology research and development for Army ground combat and tactical vehicle applications. Primary thrusts for this activity include advanced power and energy technologies for tactical and non-tactical ground vehicles, electric infrastructure and alternative energy for installations and bases, vehicle networking and connectivity to maximize overlap between commercial and military requirements. Active outreach to industry, academia and other government agencies develops new thrust areas for this project to maximize shared commercial and government investment.

This project supports Army science and technology efforts in the Ground portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, Michigan.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Power, Energy and Mobility:	4.494	4.081	4.238
Description: This effort investigates dual use power, energy, and mobility technologies leveraging commercial and academic investment to military application. This effort focuses on technologies such as light weight composite materials, electrification of engine accessories, alternative fuels, hybrid vehicle architectures, and compact electrical power generation in order to maximize common investment to meet Army ground vehicle requirements. This work is done in conjunction with PEs 0603005A and 0603125A.			
FY 2013 Accomplishments: Continued the development and integration of dual use power, energy and weight reducing components such as lightweight composites, electrification of engine accessories and compact electrical power generation into non-tactical vehicles for fuel consumption and mobility improvement; conducted operational assessments of advanced propulsion vehicles on military			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H77 / *National Automotive Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
installations; pursued dual use automotive technology collaborations with other government agencies, industry and university partners. ***FY 2014 Plans:*** Continue to partner with other government agencies such as the Department of Energy (DOE) through cooperative alliances such as the Advanced Vehicle Power Technology Alliance (AVPTA); continue to support the transition of technology to/from industry and government; leverage both industry and government facilities for evaluation, integration and testing; develop new manufacturing processes and material technologies to reduce platform weight through lightweight composite materials and novel material joining; continue to pursue collaborations with industry and university partners to develop dual use, energy efficient, automotive technologies. ***FY 2015 Plans:*** In collaboration with the Department of Transportation, will leverage activities in the active safety and autonomy areas to exploit efficient fuel vehicle operation over military platforms and duty cycles. Will initiate next generation of joint activities under the AVPTA vehicle efficiency alliance with the Department of Energy. Will initiate modeling and simulation of advanced vehicle technologies with DOE Alliance activities. Will investigate energy efficient lubrication potential to produce a significant savings in overall fuel efficiency for our fleets. This work will be coordinated with PE 0603125A.			
Title: Dual Use Technologies: ***Description:*** This effort investigates, researches and evaluates ground vehicle technologies with both military and commercial applications such as renewable energy technologies, electrical power management between vehicles and the grid, alternative fuels, and advanced vehicle networking and communication (telematics). This effort maximizes commercial technology investment for military applications in line with the National Automotive Center's Charter. Collaborations with industry, universities and other government agencies on standards writing for joint applications will facilitate this activity. This work is done in conjunction with PE 0603005A. ***FY 2013 Accomplishments:*** Pursued, identified and leveraged dual use technology opportunities to benefit both commercial industry and military application through active partnering and outreach; matured vehicle-to-grid and grid-to-vehicle technology and standards; emphasized the use of renewable energy sources to solve military energy problems for base applications; continued to support the transition of distributed power generation hardware to PM Mobile Electric Power and other materiel developers; pursued vehicle based telematics (vehicle networking and communication) solutions in support of Homeland Defense. ***FY 2014 Plans:*** Continue to identify, pursue, and leverage dual use technical opportunities with both military and industry application through active partnering with industry/academia/other government agencies as well as other consortiums/forums/alliances and	10.201	10.950	11.402

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H77 / *National Automotive Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
associations such as the Hybrid, Electric and Advanced Truck Users Forum; continue to focus on technologies that will help solve vehicle and installation energy problems; continue University applied research in areas including off-road vehicle dynamics and controls, soldier/vehicle interaction modeling, high-performance/lightweight structures and materials, alternative propulsion systems, advanced thermal management, and vehicle system design optimization for reliability and robustness. ***FY 2015 Plans:*** Will continue to partner with the Department of Transportation to leverage both traditional crash worthiness as well as active safety and autonomous driving. Other areas of collaborative research will include component safety, human interface and distracted driving technologies. Continue to leverage the commercial automotive and trucking research and development centers at the OEM and tier suppliers to bring reliable, affordable technology solutions to our military ground vehicle fleet.			
Accomplishments/Planned Programs Subtotals	14.695	15.031	15.640

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602601A / *Combat Vehicle and Automotive Technology*	Project (Number/Name) H91 / *Ground Vehicle Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H91: *Ground Vehicle Technology*	-	22.222	22.501	25.829	-	25.829	24.022	25.483	26.270	25.915	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project designs, develops, and evaluates a variety of innovative enabling technologies in the areas of vehicle concepts, virtual prototyping, electrical power, thermal management, propulsion, mobility, survivability, vehicle diagnostics, fuels, lubricants, water purification, intelligent systems, autonomy-enabled systems, and other component technologies for application to combat and tactical vehicles.

This project supports Army science and technology efforts in the Ground portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, Michigan. Efforts in this project are closely coordinated with the Army Research Laboratory (ARL), the Defense Advanced Research Projects Agency (DARPA), the U.S. Army Engineer Research, Development, and Engineering Center, Edgewood Chemical Biological Center, and the Army Medical Department.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Pulse Power:	0.997	0.961	3.369
Description: This effort focuses on growing compact, high frequency/high energy/high power density components and devices for several advanced electric-based survivability and lethality weapon systems. Technologies include direct current (DC) to DC chargers, high energy batteries, pulse chargers, high density capacitors, and solid state switches. This effort is coordinated with PEs 0603005A and 0602705A.			
FY 2013 Accomplishments: Investigated silicon carbide (SiC) and fast discharge high energy density capacitors based components for electro-mechanical armor to protect ground vehicles from the next generation threats at reduced platform weight.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Perform component development of advanced electrified armor components, and directed energy systems components related to survivability and lethality including high voltage solid state devices and high energy density capacitors and continue component development to decrease space, volume and thermal requirements while increasing performance. ***FY 2015 Plans:*** Will fabricate electrified armor and pulse power components for validation at the subsystem level against MILSTD810G test procedures, thermal, rain and salt testing, shock/vibration and performance testing. Will conduct road testing and soldier in the loop testing with electrified armors for safety and performance validation.			
Title: Propulsion and Thermal Systems: ***Description:*** This effort researches, designs and evaluates high power density engines and transmission systems needed to offset increasing combat vehicle weights (armor), increased electrical power generation needs (onboard communications, surveillance and exportable power), improved fuel economy (fuel cost & range), enhanced mobility (survivability), and reduced cooling system burden (size, heat rejection). This effort also researches and matures thermal management technologies and systems including heat energy recovery, propulsion and cabin thermal management sub-systems to utilize waste heat energy and meet objective power and mobility requirements on all ground vehicles. Lastly, this effort maximizes efficiencies within propulsion and thermal systems to reduce burden on the vehicle while providing the same or greater performance capability. This effort is coordinated with PE 063005A. ***FY 2013 Accomplishments:*** Conducted combat and tactical powertrain simulation and component designs; investigated novel high power density, low heat rejection, fuel efficient engine technologies to address increasing combat vehicle weights and thermal burden issues; assessed waste heat recovery feasibility from the engine compartment and innovative thermoelectric generator designs to achieve greater conversion to onboard electricity. ***FY 2014 Plans:*** Investigate and create concepts for a high power density low heat rejection, fuel efficient engine technology that is scalable and modular for combat and tactical vehicles to address increasing vehicle weights, commonality and thermal burden issues and develop an advanced fan design to provide for a more efficient cooling capability for the engine to increase the overall system capability. ***FY 2015 Plans:*** Will investigate waste heat recovery applications for military vehicles to increase system efficiencies. Will investigate grill designs for greater cooling capability. Will design and fabricate a high power density, low heat rejection, fuel efficient engine technology	4.313	3.056	4.465

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
that is scalable and modular for combat and tactical vehicles to address increasing vehicle weights, commonality and thermal burden issues that are not available in commercial-off-the-shelf engines specific to military applications.			
Title: Power Management Technologies: ***Description:*** This effort investigates power management technologies, software, and implementation approaches. Technologies include Alternating Current (A/C) to Direct Current (DC) inverters, DC-DC converters, solid state circuit protection, power distribution, and automated control of complete power systems. Special emphasis has been placed on developing high temperature capable power electronics, leading to the use of Silicon Carbide (SiC) in the above technologies. This effort coordinates with PE 0603005A, Projects 497 and 441. ***FY 2013 Accomplishments:*** Developed a common vehicle power management control architecture as well as wrote and evaluated power control software, designed high voltage power electronics with high operating temperatures to be further matured in PE 0603005A, project 497. These technologies optimized power distribution and minimize thermal burdens on the vehicle as demands for greater electrical power continue to increase. ***FY 2014 Plans:*** Design and develop Silicon Carbide-based power electronics for power conversion, distribution, and control in order to implement the next generation, open, non-proprietary electrical power architecture for military ground vehicles and merge power management efforts from FY12 with architectural developments in FY12 and FY13 in order to be ready to demonstrate in FY15 the fuel savings (at least 10% on a 72-hour combat mission) power management brings when combined with an advanced electrical power architecture. ***FY 2015 Plans:*** Will test Silicon Carbide-based power electronics for power conversion, distribution, and control to implement the next generation, open, non-proprietary electrical power architecture for military ground vehicles. Will continue development of the power management algorithms and software for the next generation power architecture. Will demonstrate power management and advanced electrical power architecture fuel savings gains of at least 10% on a 72-hour combat mission. Will begin integration of the components for the next generation power architecture into a Systems Integration Lab to demonstrate SiC and automated power management.	1.907	1.903	2.826
Title: Power Electronics, Hybrid Electric and On-Board Vehicle Power (OBVP) Components: ***Description:*** This effort researches, designs and evaluates high temperature and efficient power generation components to provide increased electrical power and reduced thermal loads using high operating temperature switching devices and advanced electrical generation components such as integrated starter generators and integrated starter alternators. This effort also	1.958	2.417	1.328

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
researches, designs and evaluates advanced control techniques for power generation components to make these systems more efficient, increase electrical power output and reduce thermal loads. This effort researches, develops and evaluates technologies to increase OBVP for vehicle systems such as advanced computing, sensors, survivability and communications systems that have driven electrical power demands on ground vehicle platforms beyond current generation capability. ***FY 2013 Accomplishments:*** Developed OBVP generation components; modeled and validated electric machines and power electronics hardware that met performance requirements for military ground vehicle electrical power needs. ***FY 2014 Plans:*** Investigate vehicle efficiency, space and weight impacts of OBVP generation in a system laboratory that includes the vehicle power pack and supporting auxiliary systems; compare OBVP system performance versus the performance of the conventional system; investigate the potential controls strategy enhancements of system operation where speed/power of auxiliary systems are easily manipulated; investigate vehicle level benefits (efficiency, space, weight, ambient temperature operating range) of high temperature power electronics versus traditional power electronics for power generation. ***FY 2015 Plans:*** Will investigate approaches to further electrify and control parasitic vehicle automotive loads and increase efficiency; will model and simulate tracked vehicle performance OBVP technologies integrated; will investigate approaches to implement mild hybrid (system that integrates electric machines to assist internal combustion engines for propulsion) capabilities on OBVP equipped vehicles; specifically intelligent engine start/stop strategy, architecture and controls to dramatically reduce engine idling.			
Title: Advanced Non-Primary Power Systems: ***Description:*** This effort researches, investigates, conducts experiments and validates Auxiliary Power Units (APUs) technologies such as modular/scalable engine based APUs, fuel cell reformer systems to convert JP-8 to hydrogen, sulfur tolerant JP-8 fuel cell APUs and novel engine based APUs for military ground vehicle and unmanned ground systems. This effort also determines inputs for APU interface control documents, as well as investigates solutions for reducing APU acoustic signature for silent operation during mounted surveillance missions. This effort investigates the use of small engines and JP-8 fuel cell systems for use as prime power solutions for unmanned ground systems. ***FY 2013 Accomplishments:*** Investigated modular/scalable small engine technologies, developed fuel injection strategies and validated their application for use as auxiliary power units for military ground vehicles and unmanned ground systems in order to reduce fuel consumption and meet the increasing power demands of military vehicles. ***FY 2014 Plans:***	2.958	3.113	3.052

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Investigate engine based 10 kW Auxiliary Power Unit (APU) oil consumption reduction technologies in order to decrease maintenance intervals and increase reliability; conduct experiments on acoustic treatments for engine based APUs; conduct sulfur tolerant JP-8 reformer experiments; and conduct initial assessment of fuel cell based APU solutions. ***FY 2015 Plans:*** Will investigate technologies that would enable a 20kW fuel cell APU; will begin initial experiments on increasing fuel cell components resistance to sulfur; will begin initial experiments of high power rotary engine APU designs; will begin investigating noise mitigation solutions for high power rotary engine APUs.			
Title: Elastomer Improvement Program: ***Description:*** This effort researches, formulates and tests new elastomer (rubber) compounds for vehicle track systems to increase track system durability, reduce track system failures and reduce Operations & Sustainment (O&S) costs related to premature track system failures. ***FY 2013 Accomplishments:*** Integrated advanced nano-composites into elastomer designs and formulations to increase durability and reduce flammability of materials. Fabricated and tested novel running gear elastomers designs to reduce maintenance and increase system durability. Performed laboratory testing of new compounds to validate the new materials/properties were exceeding the properties of existing materials. ***FY 2014 Plans:*** Expand integration of short fibers into elastomer compounds to augment durability and increase abrasion resistance; fabricate American Society for Testing and Materials (ASTM) samples and perform laboratory evaluation of short fiber infused elastomer coupons to determine material property improvements; and fabricate vehicle test articles and perform on vehicle testing to validate laboratory based improvements to material compound changes. ***FY 2015 Plans:*** Will perform analysis of previously tested short fiber materials; will optimize fiber orientation and validate through laboratory testing; will analyze combining short fiber material with novel other fillers to further reduce black carbon in the elastomer material; will perform laboratory testing of optimized compounds.	0.995	0.989	0.662
Title: Intelligent Systems Technology Research: ***Description:*** This effort investigates improved operations of manned platforms through the application of sensing and autonomy technologies developed for unmanned systems such as maneuver and tactical behavior algorithms, driver assist techniques, autonomy kits, advanced navigation and planning, vehicle self-protection, local situational awareness, advanced perception,	7.847	6.535	7.592

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
vehicle and pedestrian safety, active safety, and robotic command and control. This effort supports the Occupant Centric Platform program. ***FY 2013 Accomplishments:*** Expanded development of tactical behaviors utilizing common frameworks and control interfaces to provide drive-by-wire capability to the tactical wheeled fleet; extended this capability to the combat fleet, emphasizing combat-unique mission sets and payloads; investigated advanced sensors and control software; continued to advance autonomy and cognition to enable manned/unmanned collaboration and teaming; matured command and control software to enable single-operator control of multiple unmanned vehicles. ***FY 2014 Plans:*** Develop advance active safety systems to include controls, algorithms and associated hardware onto manned/unmanned wheeled vehicles; increase performance of perceptive sensors and planning algorithms and integrate on to robotic platforms for safe operations in dynamic environments; and refine tactical behaviors for mission execution on robotic platforms. ***FY 2015 Plans:*** Will extend the capabilities of active safety systems for military vehicles to reduce soldier injury due to vehicle accidents and rollovers; will advance capabilities for manned/unmanned teaming; will enhance command and control software to enable single-operator control of multiple unmanned systems; will refine algorithms, sensor fusion, dismounted behaviors, and soldier-robot interaction capabilities to enable mission planning and execution in dynamic environments; will further development of interoperability profiles and mission package integration; will develop capabilities for longer-duration/higher-tempo operations.			
Title: Energy Storage: ***Description:*** This effort investigates novel advanced ground vehicle energy storage devices such as advanced chemistry batteries and ultra capacitors for starting, lighting, and ignition and silent watch requirements for powering vehicle electronics and communications systems with main engine off. Develop and test energy storage devices to meet harsh military requirements that far exceed commercial requirements such as extreme temperature operation (-46 to +71C), ballistic shock and vibration, and electromagnetic interference (in accordance with MIL-SPEC 810G). Designs and develops advanced batteries to reduce battery volume and weight while improving battery energy and power densities within the same footprint and standardized form factor (6T) to enhance logistics. ***FY 2014 Plans:***	-	2.386	2.535

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Conduct initial experiments to validate performance of novel materials (anode, cathode, electrolyte, and separators) for cell and battery module (series of cells in series or parallel) with improved energy density and power density in the same form factor as the existing batteries for extended silent watch durations. ***FY 2015 Plans:*** Will integrate novel battery materials (anode, cathode, electrolyte, and separators) into battery cells designed to fit into existing military battery form-factors (ex: 6T); will improve existing advanced 6T battery pack prototypes and designs by incorporating new cell technologies and refining their battery management systems, control algorithms, and physical construction for shock & vibration and Electro-Magnetic Interference (EMI); will improve 6T battery designs for manufacturability, commonality and cost reduction; will validate improved 6T designs against latest battery & vehicle safety and performance requirements.			
Title: Petroleum, Oil, and Lubricant (POL) Products: ***Description:*** This project focuses on creating and evaluating innovative petroleum, oil and lubricant (POL) products that reduce logistic burdens, maintenance requirements, and fuel consumption. Products will be developed in areas such as alternative fuels, fuel additives, lubricants, power train fluids, coolants, and petroleum, oil, and lubricant products to support new military technology requirements such as anti-lock brakes and semi-active suspension. ***FY 2013 Accomplishments:*** Initiated design and evaluation of POL products to meet new military technology requirements, such as anti-lock brakes and semi-active suspensions, while exceeding future and legacy equipment performance and technical requirements; began research and design of lubricants and fluids which promoted improved energy efficiencies, improved performance and improved longevity; characterized alternative fuels and fuel additives that improved performance and diversify energy sources; initiated research and evaluation of nanofluid technology that suspends nanoparticles in coolants and lubricants to improve thermal, friction, and wear properties. ***FY 2014 Plans:*** Identify candidate fuel efficient gear lubricants and hydraulic fluids to improve ground system performance and reduce logistics burden; evaluate new alternative fuels and fuel additives that may improve performance and diversify energy sources; and identify candidate POL products with high potential to meet new military technology requirements while ensuring legacy equipment performance and technical requirements are maintained.	1.247	1.141	-
Accomplishments/Planned Programs Subtotals	22.222	22.501	25.829

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602601A / *Combat Vehicle and Automotive Technology*	**Project (Number/Name)** H91 / *Ground Vehicle Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A